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## (54) DEVICE FOR THE ADMINISTRATION OF POWDERS

(71) We, BEECHAM GROUP LIMITED, a British company, of Beecham House, Great West Road, Brentford, Middlesex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a device for oral inhalation of finely divided powders and in particular for us in bronchoradiography.

Radiography of the bronchial tract is of great diagnostic value in the investigation of disorders of that region, and involves the administration of a radio opaque substance to the lungs of a patient prior to radiography. It is known that such substances may be administered for example as aqueous solutions or dispersions or as a liquid aerosol. However the most advantageous method of administration comprises the direct insufflation of the radio-opaque material in the form of a powder of sufficiently small particle size to reach the fine airways of the lung. Devices are known for the administration of powders by inhalation, but many require an additional source of power besides the patient's inhalation to blow the powder out of the device. Examples of such additional sources of power include, for example, a rubber squeeze bulb (see Belgian Patent No. 764,576) or a source of gas under pressure (see British Patent No. 1,305,172). In such devices it is difficult to synchronise the patient's inhalation with the operation of the additional source of power. Other inhalation devices, which are activated solely by the users' inhalation, are described in British Patent Nos. 1,118,341, 1,182,779, 1,122,284, 1,295,081, 1,301,856, U.S. Patent No. 3,635,219, Belgian Patent No. 781,102 and our Britisih Patent No. 1,404,338.

All these devices, however, are designed for oral administration of relatively small quantities of powder at a time and are insufficient for the requirements of radiography, in which a total powder charge in the range 5—15 grams may be required.

We have now produced an inhalation device capable of handling these larger amounts of powder.

According to the present invention, there is provided a device for the oral inhalation of powders, which device comprises a hollow elongate housing having an outlet at one end thereof adapted for application to the mouth, the interior of the housing communication at the other end thereof with the interior of a container for powder; first air inlet vents terminating in the container adapted to direct incoming air into a turbulent stream within the container; second air inlet vents adapted to direct incoming air into a vortex within the housing; whereby the intake of breath by the user of the device causes powder within the container to be fluidised, to pass into the vortex of air in the housing and thence through the outlet to the mouth of the user.

One embodiment of the invention will now be illustrated with reference to the accompanying drawings wherein:

Fig. 1 is a cross-section through the major axis of an oral inhalation device in accordance with this invention;

Fig. 2 is a cross-section through the line B—B of Fig. 1;

Fig. 3 is across-section through the line A—A of Fig. 1;

Figs. 4 and 5 are cross-sections through upper portions of two alternative devices in accordance with this invention;

Fig. 6 is a cross-section through the line C—C of Fig. 4;

Fig. 7 is a cross-section through the line D—D of Fig. 5.

Referring to the drawings, the inhalation device comprises a hollow elongate housing 1, made of plastics material. One end of the housing is provided with an outlet 2 of restricted diameter which serves as a mouthpiece. The other end of the housing 1 is provided with a powder container 3 com-

prising a body 4, the interior of which is cylindrical, separably connected by a screw thread 7 to a flange 5. The flange 5 is integral with the housing and forms a top for the container. A tubular extension 6 of the housing protrudes into the container. The base 8 of the container has a central protuberance 9 producing an annular trough 10. In this embodiment the first air inlet vents 11 terminating in the container are provided in the flange 5. The vents 11 are drilled at an angle to the axis of the cylindrical interior of the body 4 this angle preferably being in the range 40—85°. The configuration of these vents is shown more clearly in Fig. 2. The housing 1 has second inlet vents 12 which are inclined as shown in Fig. 3. The vents 12 may be disposed at an angle from 10—80° to a radius of the cylindrical interior of the housing. The outlet 2 is also provided with an extension 13 which projects into the housing 1, leaving an annular space 14.

In operation of the device, the housing 1 is maintained in a vertical position.

Powdered medicament is placed in the container body 4, which is then assembled onto the flange 5 by means of the screw thread 7. The patient inserts the portion of the housing in the vicinity of the outlet 2 into his mouth and inhales. Air is drawn into the device through the inlet vents 11 and 12. Air entering through the inlet vents 12 causes a vortex to develop within the housing 1. Air entering the inclined inlet vents 12 passes into the powder container 3, thereby fluidising its contents and produces a vortex motion of air within the container 3. The powder is entrained in this circulating airstream and thus prevented from passing straight up the extension 6. The heavier particles of powder are flung outwards against the walls of the container 3, but the finer particles will be drawn through the extension 6 and into the circulating airstream present in the interior of the housing 1. As the heavier particles circulate in the container 3 they are subject to attrition on the side walls of the container until they are sufficiently reduced in size to escape through the extension 6. The powder circulating within the housing 1 is drawn towards the outlet 2 and approaches an outlet extension which acts as a classifier for powder. Large particles become trapped behind the extension in the annular space 14 between the extension and the inside wall of the housing. Again only the finer particles in the stream are drawn through the outlet 2 and into the patient's lungs. Coarser particles are held back within the space 14 until they are reduced in size by attrition sufficiently to also escape through the central extension 13 and thence through the outlet 2.

In this embodiment, the base 8 of the container 3 has a central protuberance 9. This provides an annular trough 10 for the powder and reduces the likelihood of a dense cloud of powder passing towards the outlet 2 at the onset of inhalation.

Two alternative forms of outlet are depicted in Figs. 4 and 5. In Fig. 4 the outlet 102 is in the form of a curved tube attached to the upper end of the housing 101. An extension 113 which acts as a classifier is again provided within the housing 101. The end of the outlet 102 is elliptically shaped, as shown in Fig. 6 for easy application to the mouth. With the configuration shown in Fig. 4, the device can be held upright whilst the patient inhales through the outlet 102.

In Fig. 5, the outlet of the device is in the form of an extension 202 integral with the housing and is tangential to the inner cylindrical side wall of the upper portion 201a. The configuration of the extension 202 is shown more clearly in Fig. 7. An extension 213 acts as a classifier. The end of the outlet 202 is again elliptically shaped for insertion into the mouth.

In alternative embodiments of devices according to this invention, the powder container may be separable into two parts at any point and may be adapted to be reassembled by alternative means to that illustrated above, for example by a snap-on/snap-off locking mechanism. If the container is separable so that one part is in the form of a flange integral with the housing, as shown above, then the flange may be adapted to fit onto a standard screw-top bottle in which the powder may be stored prior to use.

The inlet vents into the container may be in the sides or the top of the container. In order to produce the required turbulent stream, these inlets may be angled as described above, or they may be positioned adjacent internal angled barriers so that incoming air is directed to a circular path. Similarly the inlet vents in the elongate housing may be angled or they may be positioned adjacent internal angled barriers. Preferably the inlet vents in the housing are positioned approximately midway between the outlet and the powder container.

WHAT WE CLAIM IS:—

1. A device for the oral inhalation of powders, which device comprises a hollow elongate housing having an outlet at one end thereof adapted for application to the mouth, the interior of the housing communicating at the other end thereof with the interior of a container for powder; first air inlet vents terminating in the container adapted to direct incoming air into a turbulent stream within the container; second air inlet vents adapted to direct incoming air into a vortex within the housing; whereby the intake of breath by the user of the device causes powder within the container to be fluidised, to pass

into the vortex of air in the housing, and thence through the outlet to the mouth of the user.

2. A device as claimed in claim 1 wherein the housing interior is cylindrical and the second air inlet vents are disposed within the housing at an angle from 10—80° to a radius of the interior.

3. A device as claimed in claim 1 or claim 2 wherein the first air inlet vents are in the top of the container.

4. A device as claimed in claim 3 wherein the interior of the container is cylindrical and axially aligned with the longitudinal axis of the housing and the first inlet vents ar disposed at an angle in the range 40—85° to the axis of the container.

5. A device as claimed in any of the claims 1 to 4 which has a means for allowing only fluidised powder to pass from the container into the housing.

6. A device as claimed in claim 5 wherein said means is provided by a tubular extension to the housing protruding into the interior of the container.

7. A device as claimed in any one of claims 2—6 wherein the oulet is in the form of a tube having its longitudinal axis at right angles to that of the housing.

8. A device as claimed in any one of claims 1 to 6 wherein the outlet is in the form of a curved tube attached to the upper end of the housing.

9. A device as claimed in claim 7 wherein the outlet is in the form of an extension integral with and tangential to an upper portion of the housing.

10. A device as claimed in any one of claims 1—9 wherein the end of the outlet is elliptical in cross-section.

11. A device as claimed in any one of claims 1—10 which further comprises means between the second air inlet vents and the outlet to separate fine particles of powder from coarser particles.

12. A device as claimed in any one of claims 1—11 which device is separable into two parts.

13. A device as claimed in claims 1 to 12, which has an internal protuberance centrally arranged within a base portion of the container.

14. A device as claimed in any one of claims 1—6, 11—13 substantially as described with reference to the accompanying Figs. 1—13.

15. A device as claimed in any one of claims 1—6, 8, 10—13 substantially as described with reference to the accompanying Figs. 4 and 6.

16. A device as claimed in any one of claims 1—7, 9, 11—13 substantially as described with reference to the accompanying Figs. 5 and 7.

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1478138 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

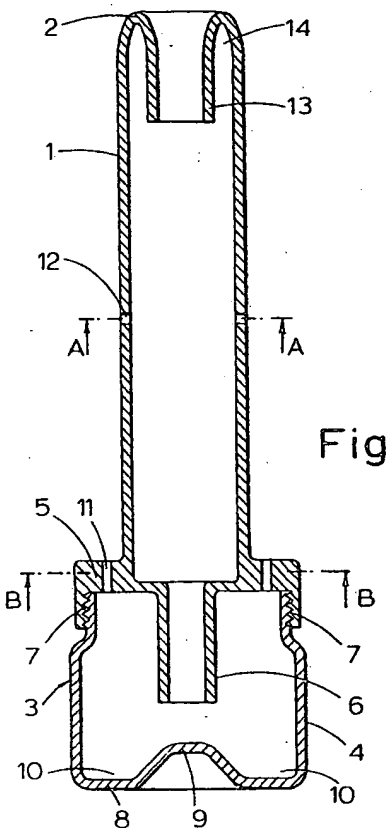


Fig.1

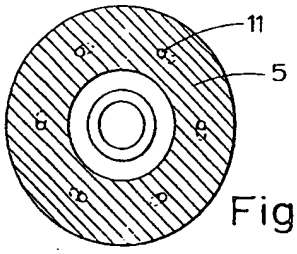


Fig.2

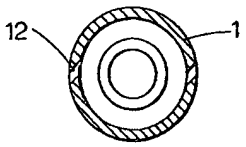


Fig.3

1478138 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

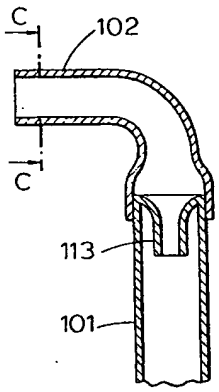


Fig.4

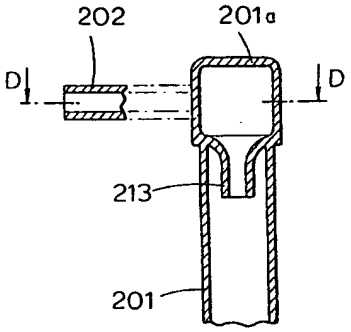


Fig.5

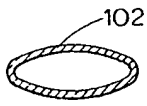


Fig.6

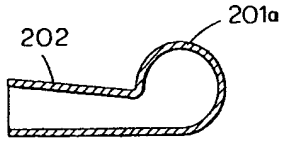


Fig.7